



THE CASE FOR
CONTINUED SMALLPOX VACCINATION^a

by

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Smallpox has been one of the most serious of the diseases afflicting mankind. With no respect for social class, it took its toll from the nobility and commoner alike. It was present in Europe, Asia, Africa, and was brought by the early explorers to the Western Hemisphere where it greatly influenced the ultimate conquest and political boundaries. The pock-marked complexion was normal. The likelihood of acquiring and dying from smallpox was so great that variolation, the deliberate inoculation of smallpox material into the nose or skin of the healthy person, was considered a wise gamble, even though two to eight of each hundred persons would die from the resulting smallpox. These odds were clearly better than the 30 to 50% who would die if they acquired the natural disease without protection. Until recently, there have been societies among whom babies were not given a name until they had survived their inevitable attack of smallpox; it would seem that the baby supply exceeded the supply of names (or the cost involved in a naming ceremony)! Lord Macaulay¹ paints the picture of the times when he wrote that smallpox

"was then the most terrible of all the ministers of death. The havoc of the plague had been far more rapid, but the plague had visited our shores only once or twice within living memory; and the smallpox was always present, filling the churchyards with corpses, tormenting with constant fears all whom it had not yet stricken, leaving on those whose lives it spared the hideous traces of its power, turning the babe into a changeling at which the mother shuddered, and making the eyes and cheeks of the betrothed maiden objects of horror to the lover. Towards the end of the year 1694, this pestilence was more than usually severe. At length the infection spread to the palace, and reached the young and blooming Queen."

The situation today presents a delightful contrast. To the bulk of the world's population, smallpox is an exotic disease. Pock marks are seen rarely if at all, usually among the older people. Except for a very small number of peripatetic individuals, United States physicians of today have never seen a case of smallpox. In their medical education, save for allusions to the disease, smallpox, its recognition and management are not "relevant" to the needs of the U.S. physician and are left uncovered. The domain of smallpox has been steadily constricted. In the mid-forties, approximately eighty countries reported smallpox; in 1972, continuing transmission of disease is being reported from only seven countries on two continents (India, Pakistan, Bangladesh, and Nepal in Asia and Ethiopia, Sudan, and Botswana

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in Africa). Smallpox was introduced and controlled in Yugoslavia, Germany, South Africa, Uganda, Iran, Iraq, Syria, Sri Lanka (Ceylon), and the African French Territory of Afars and the Issas. During 1972, endemic disease was controlled in Indonesia with no new reported cases after January, and in Afghanistan with no new cases since October.²

How was this accomplished? The basic tool was presented to the professional community 175 years ago, but no dramatic decrease in the incidence of smallpox ensued. From the beginning, vaccination was resisted by an aggressive antivaccination movement; this was justified on theological grounds but was nurtured by fear of the illness associated with the vaccinal infection, necessary for immunity to develop. To complicate the case further, many of the early vaccines were low or lacking in vaccinia virus while replete with pyogenic bacteria, hepatitis virus, or other pathogens, so that vaccination could produce illness without conferring immunity to smallpox. To achieve a vaccinal infection when virus content was so low, vaccine was applied over large areas of skin using elaborate scarifiers, multiple insertion sites, cruciate incisions, etc. The subsequent severe reactions, which not infrequently followed, did the cause little good.

The use of the skin of the calf for propagating the virus eliminated the hazard of transmission of human disease. The establishment of laboratory controls, enforced by governmental authority, assured a product free of disease-producing contaminants and, at least at the time of production, a reasonable level of vaccinal infectivity as judged on the rabbit skin. Vaccine strains which produced larger and more consistent takes were selected, and "virulence" was fortified by man-rabbit-calf passages; this was to assure that each vaccination did in fact produce immunity.

In the United States, smallpox vaccination was made compulsory for school admission in most states. The technique of vaccination in general use was modified by the introduction of the multiple pressure technique in the late twenties. Smallpox can be considered to have become nonendemic in the United States by the mid-thirties, although isolated outbreaks did occur among nonvaccinated groups. However, the occurrence of smallpox among "vaccinated" military personnel and the introduction of the disease by them to the West Coast in 1946 drew attention to the need for a more potent vaccine for revaccination than for primary vaccination. This had been recognized by Leake,³ who specified six to ten pressures in the multiple pressure vaccination technique for primary vaccinations, but thirty pressures for revaccination. The question whether there should then be two smallpox vaccines, one for domestic use and one for revaccination of those who were to be at high risk of exposure, was resolved by the development of freeze-dried vaccine and greater attention to production and storage factors to assure high potency in stocks of liquid glycerinated vaccine.

The dramatic results of the WHO Smallpox Eradication Programme are based on the availability of potent stable smallpox vaccine (freeze-dried), nontraumatic techniques for its administration (intradermal jet injection and then the bifurcated needle in the multiple puncture technique), a surveillance programme which detects cases early and breaks the chain of transmission to or from the contacts of the patient, and systematic vaccination.⁴ When the programme was initiated in 1967, smallpox was reported from forty-two countries; in twelve of these, the cases had been imported and disease was not considered endemic. Today, as noted above, in only seven or eight countries is smallpox still endemic, and WHO has set a goal for global eradication by April 1974.

On September 25, 1971, the United States Public Health Service Recommendation on Smallpox Vaccination was published, accepting the recommendation formulated by its Advisory Committee on Immunization Practices,⁵ which was:

"The Committee has reviewed the success achieved so far by the World Health Organization (WHO)-sponsored smallpox eradication effort and fully expects that it will continue. It now believes that the risk of smallpox in the United States is so small that the practice of routine smallpox vaccination is no longer indicated in this country.

The Committee believes that public health efforts should be devoted to assuring adequate immunization of all personnel involved in health services and of all travellers to and from continents where smallpox has not been eradicated.

Because of the rapidly declining incidence of smallpox in the world and the vastly reduced risk of its being imported into the United States, health officials in the United States should consider the discontinuation of compulsory measures as they relate to routine smallpox vaccination.

The Public Health Service should regularly evaluate and distribute information on the progress toward worldwide smallpox eradication. This will provide a basis for future assessment of smallpox vaccination practices in the United States.

Finally, physicians and public health agencies should intensify efforts to assure that all adverse vaccine reactions are reported and that the following contraindications to smallpox vaccination are scrupulously observed: (1) eczema and other forms of chronic dermatitis in the person to be vaccinated or in a household contact; (2) pregnancy; (3) altered immune states from disease or therapy."⁶

The Center for Disease Control states: "The decision of the Public Health Service to institute a policy of selective vaccination against smallpox in the United States was made only after the careful examination and quantification of many factors, including the risk of complications following smallpox vaccination, the probability of smallpox importation into the United States, and the anticipated extent of smallpox spread after importation."⁶

This decision has been welcomed by those who are worried by the risk of complications in their patients, and greatly disturbs those who are concerned with the continued health of the community. The factors on which the decision was made bear re-examination.

RISK OF COMPLICATIONS FOLLOWING SMALLPOX VACCINATION. The strongest argument against continued routine smallpox vaccination lies in the risk of one death per million primary vaccinations based on the 1963⁷ and 1968⁸ national surveys in the United States. In contrast, there have been no deaths from smallpox in this country since 1949. Based on European experience with smallpox importations, it is estimated that there might be twenty smallpox deaths between 1969 and the end of the century if vaccination is discontinued, against the 210 deaths from smallpox vaccination itself which would occur with the continued routine vaccination programme, based on the rate of seven deaths per year.⁹ These data would be a serious contraindication to continued vaccination if valid, but their validity is subject to question.

There is no doubt that vaccinia virus can, under certain circumstances, become an invasive pathogen. The induced infection with vaccinia virus is terminated by the emergence of active immunity. Vaccination of those with immune deficiencies is hazardous, with the danger that the lesion will continue to progress to become progressive vaccinia (vaccinia necrosum). While this had previously carried a high case fatality rate, its

prognosis has been greatly improved by the use of vaccinia immune globulin and thiosemicarbazone. In 1963,⁷ nine cases were reported with no deaths; in 1968,⁸ eleven cases with four deaths were reported. Eight of the 1968 cases were over fifteen years of age; seven (including one with "unknown vaccination status") followed revaccination. Of these, two had leukaemia, three Hodgkin's disease, and one lymphoma. Among the four deaths, one was a sixty-two-year-old woman with chronic lymphatic leukaemia, revaccinated as treatment for recurrent herpes simplex (!), another death followed primary vaccination of a microcephalic with cerebral palsy, and the third followed primary vaccination of a sixteen-year-old girl "with previously undetected aplastic anaemia." The fourth fatal case was a six-year old boy with acute myelogenous leukaemia which was in remission on vincristine and prednisone therapy; the vaccinal lesion cleared and was considered "cured" but he died approximately one month later of his leukaemia. Whether this death is properly attributed to vaccination is a matter of judgment. It would seem that pre-existing disease was probably known in all these cases but possibly two - a twenty-two-month-old boy with Bruton's hypogammaglobulinaemia and the girl with aplastic anaemia (whose pallor should have been a warning). The patients with malignancy, the one on antimetabolite therapy and the one on anticoagulants for ischaemic heart disease should not have been vaccinated unless exposed to smallpox. If vaccination is restricted to those who are well and thriving,¹⁰ the problem of vaccinia necrosum will be greatly reduced.

Postvaccinal encephalitis (PVE) is a serious complication, which is noted to have an incidence of 2.9 per million primary vaccinations (and none after revaccination).⁵ "'Postvaccinal central-nervous-system disease' includes a variety of disorders manifesting signs and symptoms of classic encephalitis, encephalopathy, demyelination or neuropathy. These entities are attributed to vaccinia because of their temporal relation to smallpox vaccination and because of the absence of any other etiology. (Italics added) The pathology of these diseases is similar to that seen with other viral central-nervous-system disorders."⁸ Is it coincidental that 2.86 cases of encephalitis of unknown etiology were reported per twenty-eight day period¹¹ in 1965 in New Jersey per million children one to nine years old? During that year, cases of encephalitis of unknown etiology in the New England and Middle Atlantic area showed no seasonal aggregation.¹² These cases were collected passively; i.e., they were reported by physicians usually seeking diagnostic help. A much higher rate would be expected to be reported following vaccination, since CNS involvement is looked for and any aberrant behaviour of the child is suspected to be due to the procedure.

This is not to imply that postvaccinal encephalitis cannot be caused by vaccination, but it may well be overreported. The difference in incidence rates between the United States of one case per 345 000 primary vaccinations contrasts sharply with the Dutch experience of one in 4000. The rate of one per 152 000 primary vaccinations (6.5 per million) in the first year of life and half that rate at higher ages,⁵ contrasts with the German experience of one in 10 000 - 15 000 primary vaccinations of infants and one in 2000 - 3000 primary vaccinations among those two years or older.¹³ Studies in Hamburg of the age incidence of postvaccinal convulsions among approximately 250 000 primary vaccinations reported an incidence of one convulsion per 1049 primary vaccinations (953 per million vaccinations) of children under three years old, with a peak incidence of one per 511 (1957 per million) among those eighteen to twenty-three months old, and a minimal incidence of one per 15 405 (65 per million) in those under six months of age.¹⁴ The facts on PVE are evidently unclear; it has not been the problem in the United States that it has in European countries. It is difficult to accept genetic differences; the more rigorous vaccination techniques and more virulent strains of vaccine which have been used in Europe are more likely explanations.

The morbidity caused by vaccination has been exaggerated by the emphasis placed on the minor side reactions. For example, generalized vaccinia is cited to occur in 242 per million primary vaccinations.⁵ "The clinical spectrum of generalized vaccinia was broad... In most cases the clinical descriptions obtained were insufficient to distinguish patients with vesicular or pustular rashes from those with maculopapular or erythema-multiforme-like rashes. There were no deaths, and no patients suffered serious sequelae."⁸ And "the most common manifestation was satellite vesiculation around the vaccination site."⁷ -- To minimize this technical error we had recommended that the vaccination site not be cleaned (and thereby superficially abraded).¹⁰ Accidental infections have increased with the delay of vaccination to the second year of life and, at the worst, produce an aberrant scar. Erythematous urticarial lesions occur frequently without making the vaccinee sick. Lack of understanding of these interesting but unimportant phenomena have resulted in unnecessary concern and hospitalization. Stress is placed on exceedingly rare phenomena. There have been only about twenty cases of foetal vaccinia reported in all the medical literature and no apparent evidence that there is an increased risk of abortion, miscarriage, or foetal malformation, and virtually all after primary vaccination, but pregnancy is now accepted as a contraindication to vaccination or revaccination!

The important complications of smallpox vaccination then are largely the problems of an underlying disease, and deaths attributed to vaccination may properly be ascribed to the primary defect. Deaths were reduced by delaying vaccination to the second year of life. "As Conybeare has pointed out, in all countries delaying routine vaccination until the second year of life, the number of fatal cases due to some of the complications of vaccination will tend to diminish for by that time many of the susceptible individuals will have died from one or another infection of childhood."¹³ Encephalitis of unknown origin had its highest incidence in the first year of life.¹²

Elimination of routine vaccination, while retaining it for members of the health professions and travellers to endemic countries, assumes that primary vaccination of the adult can be carried out without a significant increase in risk. The experience of United States military personnel is cited⁹ as evidence of the safety of primary vaccination of adults; however, results obtained on a highly selected group of healthy individuals may not apply to the population at large. This United States experience is in sharp contrast to the European experience. In Austria, the incidence of PVE was fifty-five times greater among those eleven to fourteen years of age than among those one to three; deaths occurred thirty-three times more frequently.¹⁵

The mortality and morbidity from smallpox vaccination on which our policy for the future is based⁵ is that associated with the vaccine strain, the concentration of virus (potency), and vaccination method in use in the country today; as noted above, these factors were selected for control of endemic disease and not designed for the needs of today. Studies carried out in several countries have shown that certain vaccine strains, used at reduced potency, and the use of other routes of administration result in lowered morbidity.¹⁶ It has been argued that no new regimens can be validated without a field test involving millions of vaccinations since PVE occurs only approximately three times in a million primary vaccinations. The data showing that encephalitis of unknown origin, unassociated with vaccination, occurs in the same frequency suggests that we can properly focus on the fever and vaccinal illness itself as the criteria for a safer vaccination regimen. The system designed for today's, rather than yesterday's, needs should be used in calculation of risks.

THE PROBABILITY OF SMALLPOX IMPORTATION INTO THE UNITED STATES. No one can argue with the declining probability of introduction as disease is eradicated from more and more endemic foci, even with increased mass travel in jumbo jets. However, while calculations may indicate the probability of only one importation every twelve years, Monte Carlo and Las Vegas are evidences that probabilities are only probabilities.

THE ANTICIPATED EXTENT OF SMALLPOX SPREAD AFTER IMPORTATION. Again, statistical analysis of the experience in fifty-one importations into Europe in the last two decades, provides the comforting data that fifteen importations per year would be required to produce the number of deaths now associated with vaccination. This assumes "vigilant surveillance and outbreak control." Early case detection and then selective (or ring) vaccination of contacts¹⁷ is expected to contain any introduction. Reliance is placed on quarantine inspectors at international airports who will "observe travellers for signs of illness and check vaccination certificates of travellers from smallpox-infected countries."⁵

The predicted number of cases may be valid as an average over the long run. This low transmission rate is supported by observations in both Africa and Pakistan of several generations of smallpox within one family group; this is the basis for the statement that "Smallpox is not the highly contagious disease it was once thought to be."⁵ However, the microecology of smallpox is not fully understood. Transmission is clearly affected by climatic conditions - in East Bengal the disease bears the name of the season during which epidemics occur, springtime (Bashunto). While transmission usually occurs in a face-to-face contact, the outbreak in Meschede, Germany in 1970 was spread not only by air currents within the hospital, but all the evidence suggests that infection actually left the patient's room through the window, rose on updrafts along the outside of the hospital and re-entered through windows to infect one patient in the second floor room and three in third floor rooms overhead.¹⁸

The outbreak in Yugoslavia in March 1972 showed what can happen. After forty-two smallpox-free years, a traveler with a valid vaccination certificate introduced the disease from Iraq. He had so mild an illness that he did not seek medical attention but he infected eleven individuals; the contact with some of these was slight and his own illness was only uncovered in retrospect.¹⁹ One of his contacts developed haemorrhagic disease, was hospitalized in his hometown, then was transferred to a larger hospital, thence to a dermatology clinic in Belgrade as a case of "unusual drug reaction secondary to penicillin." After twelve hours he was transferred to an intensive care unit at a surgical hospital, where he died twenty-four hours after admission. Only when his brother came down with smallpox a few days later did the correct diagnosis become apparent. This one case infected two patients and one visitor in the first hospital, caused eight secondary cases in the second hospital, eight in the third hospital and eighteen in the final hospital. The last group included all thirteen patients in the intensive care unit, one doctor, one nurse, one hospital technician and a wardrobe man in charge of patients' clothing. Including his brother, this one man infected thirty-eight individuals, a new record.²⁰ This outbreak was controlled within a month, after 175 cases and thirty-four deaths. A mass vaccination campaign was carried out in which 95% and 98% of the total population of Belgrade and of the Kosovo region (where the cases originated) were successfully vaccinated. Military personnel carried out the vaccination programme; four hotels were taken over for isolation of all known contacts; in Belgrade, the Thousand Roses Motel was converted to a hospital.

Could this have happened in the United States? On entering the United States after leaving Belgrade during this outbreak, no quarantine inspectors were in evidence. Vaccination certificates were checked by the immigration officer, and a single revaccination performed forty-eight hours earlier in Belgrade was properly accepted. Analysis of importations into Europe during the period 1950-1971 showed that at least 65% or probably 85% of these importations were attributable to errors in revaccination.²¹ Under these conditions, a mild infection, such as that in the Yugoslav traveller, could easily have supervened during the next two weeks with little motivation to comply with the instructions, on the card handed out by the immigration officer, to give the "card to your physician and advise him of your recent travel outside the United States", if the card had not by now been discarded or misplaced. The rest of the episode is as probable here as in Yugoslavia; the missed diagnoses, the public panic, even the inclusion of physicians and health workers among the diseased. Had some of these exposures occurred in the New York subway system during rush hour, a problem

of greater magnitude would result. We have no isolation facilities in which we could house large numbers of smallpox patients, and in our social structure we are unlikely to requisition hotels, or to find large numbers of contacts willing to remain in quarantine facilities.

It is true that more people have died in the United States in association with (but not necessarily due to) vaccination than from smallpox. This has led to the argument that we are protecting our people from a disease which does not exist. It does not exist within our country, but it does exist and is still active among populations. Although the immune status of our population, as measured by immunity to percutaneous vaccination, is lower than ideal, there have been no importations from India during the period 1950-1971 in contrast to seven importations into Germany; three times as many Americans as Germans have been temporary visitors to India.²⁰ Discontinuing vaccination because there have been no cases is analogous to discontinuing fire preventive measures because there has been no fire. Certainly the most intensive control measures are needed near known fire sources, but serious fires still occur in new buildings built of nonburning material.

The cost of smallpox vaccination has been padded by several factors. The incidence of postvaccinal encephalitis in the United States is no greater than that of encephalitis of unknown etiology among unvaccinated persons; PVE has no specific diagnostic criterion, other than its temporal association with vaccination. There does tend to be a clustering of central nervous system symptoms nine to ten days after vaccination;⁸ this coincides with the fever after primary vaccination. Is this a real cost of vaccination? Generalized vaccinia connotes spread of vaccinia virus throughout the body with multiple foci of replicating vaccinia virus, a condition often a part of eczema vaccination; the rubric, however, as noted above, includes local lesions more properly classified as co-primary lesions and a variety of rashes which have no prognostic significance and could be considered "side reactions" rather than complications of vaccination. Finally, the "costs" are those which are produced by a methodology designed for the "attack phase" of smallpox control, rather than the "maintenance phase."

What are the prospects for global eradication? To date, we have no evidence of transmission of variola virus to man from any source other than man. The West African success gives every hope that smallpox can be eradicated. It calls for sincere determination at all governmental and health professional levels to detect and contain each possible case, without any implication that the emergency of smallpox represents personal or national failure or dishonour. Concern of the effect of a case or outbreak of smallpox on the tourist industry is best answered by the successful season enjoyed by Yugoslavia in 1972. The global eradication programme can succeed by April 1974, but this should have been actually achieved before dropping our defenses.

George Dick, who is firmly against routine childhood vaccination, wrote:¹³

"Even with the apparent eradication of smallpox throughout the world, at which we must aim, and which is the ideal solution to the problem, there is always the possibility of smallpox virus emerging from the 'backwoods' or deep freezes when we thought it had gone and also the possible (perhaps remote) use of smallpox virus in 'bacteriological' warfare. We must have a sensible policy for the control of smallpox now and in the future."

Smallpox had been an effective BW agent, but lost its effectiveness when populations were relatively immune. The development of nonimmune populations will re-establish variola as an ideal lethal BW agent, with danger persisting as long as the virus lies in the deep freeze.

That 'backwoods' may become important is shown by the isolation in Holland of virus strains from two different cynomolgus monkey kidney cell lines and in Moscow from the tissues of a chimpanzee caught in the Congo. These virus strains could not be distinguished from standard variola virus by any laboratory test. While the Dutch monkeys did come from Malaysia, which is not too far from Indonesia where smallpox was then occurring, the chimpanzee was caught in a search for monkey pox virus in an area where no smallpox had occurred for some time.

What is the sensible policy for now and the future? I disagree with the discontinuation of routine childhood vaccination, certainly for now. Until global eradication has been accomplished, we are assuming the race has been won and, like the hare, prematurely may be resting on our laurels. Our policy of no-routine-vaccination becomes a status symbol of progress, and can be expected to motivate less prepared countries to conceal their smallpox cases and prematurely drop their defenses.

Discontinuance of childhood vaccination commits us to the possibility of mass adult vaccination, as well as selective vaccination of health workers and some travellers; in all tabulations vaccination of adults involves a greater incidence of PVE and vaccinia necrosum. It is argued by the British that childhood vaccination offers no great protection against complications when revaccination is carried out in the adult. This is clearly not confirmed by United States data⁵ which indicate virtual absence of significant complications on revaccination, except for vaccinia necrosum among those with disease of the haematopoietic system. Further, the fever and morbidity of the "normal" primary take, with our present technology, can have economic implications in the adult whose vaccination is unplanned, in contrast to the indisposition of the baby who is vaccinated in prime of health.

Routine vaccination has been condemned because of the financial cost. These analyses include the cost of the physician's visit, coming to 69% of the total costs. About 30% is costed for lost earnings due to time off work for vaccination and its complications. But vaccination and revaccination should be an integral part of comprehensive health care and should not be separated therefrom and charged for separately. There is a real cost in the vaccine, but vaccine production and competence in its production will have to continue for the foreseeable future. What would the comparable cost be if there were a bona fide introduction of smallpox, such as occurred in Yugoslavia?

We recommended¹⁰ that vaccination be performed only on those in full health, using the very minimal trauma, and that all smallpox vaccinations be planned for a second procedure if a major reaction, indicative of multiplying virus, is not present seven days later; this policy I would continue. The immunizing strain, dose and route which produces immunity with minimal side reactions should be used, based on comparisons of the morbidity they produce.¹⁶ The use of sequential vaccines may prove best, but is not desirable. Contraindications to vaccination would be strictly respected. I favour vaccination of the thriving infant in the first three to six months of life, assuming the mother had been vaccinated and revaccinated; when this is done, it can be carried out with no systemic reaction. Revaccination at five to ten-year intervals will maintain immunity with safety.

I would not argue for legal compulsion to assure that all members of our society be kept in a state of full smallpox immunity. Discontinuance of routine vaccination, on a compulsory basis, could be justified on the basis that it was no longer necessary; this then permits the physician and the patient to make the appropriate decision.²² For those who are likely to go into the health services or are likely to enter the military forces or do extensive travelling, infantile vaccination of the healthy thriving infant seems safest. Even if revaccination is not performed every five to ten years, the European experience was that of 52% case fatality rates among those never vaccinated in contrast with 11% of those

whose last vaccination was over twenty years before; the contrast is even sharper among those over fifty years of age, where the comparable figures are 91% (ten of eleven) and 26% respectively;²⁰ and, as noted above, the United States data shows that the primary vaccination protects against complications of adult revaccination. Since prediction of the future life pattern is difficult, infantile vaccination in general would continue.

It is unfortunate that, in justifying the discontinuance, principal emphasis was placed on the "risks" of vaccination which were widely publicized in the news media so that there is now a public fear of vaccination. This seems to have extended to even those physicians who favour vaccination of their healthy patients but fear malpractice suits. However, truly informed consent, preferably in writing, avoids such suits and returns to the physician his obligation to give the patient the benefit of his best professional advice. This advice, and our recommendations for the future, will be subject to change when global eradication has been achieved and will strongly be influenced by the temper of the international climate at that time. While the proper action, in my judgment, had not been taken, change is permissible. Newer vaccines will justify a revision of emphasis with, I hope, a national trend toward a protected population.

I have previously used a quotation which has now become most appropriate. Written in 1802, very shortly indeed after Jenner reported the effectiveness of vaccination, it is even more pertinent 170 years later. James Bryce wrote:²³

"Dr Jenner has thus acted his part; it remains for the other members of society to act theirs; he has shown how important advantages may be obtained; it is theirs to carry this plan into execution by cooperating, both by example and by precept, to render general the practices of inoculation for cowpox; the reward being no less than exterminating one of the most loathsome and fatal disease to which mankind are liable - The smallpox. I must here, however, observe that it is not the prevention of smallpox in a country, for a few years or perhaps a century, that ought to be regarded sufficient.... If it should then unfortunately so happen that the advantages resulting from cowpox are forgotten, or undervalued... then the smallpox may again be imported from some remote corner where the influence of cowpox was unknown.... Measures might be contrived not only for rendering vaccine inoculation general, but also for continuing it with unremitting diligence throughout future ages."

REFERENCES

1. Macaulay, T. B. (1856) The History of England from the Accession of James the Second, Vol. 4, p. 369, Philadelphia: E.H. Butler and Company
2. WHO Weekly Epidemiological Record, (1972) 47, 494-496
3. Leake, J. P. (1927) Questions and Answers on Smallpox and Vaccination, Pub. Hlth. Rep. (Reprint No. 1137) 60, 221-238 (revised 1946)
4. WHO Expert Committee on Smallpox Eradication, Second Report (1972), Wld Hlth Org. techn. Rep. Ser., 493, 9
5. Center for Disease Control (1971) Morbidity and Mortality Weekly Report, 20, 339-345
6. Center for Disease Control (1971) Morbidity and Mortality Weekly Report, 20, p. 342
7. Neff, J. M. et al (1967) Complications of Smallpox Vaccination. I. National Survey in the United States, 1963. New Eng. J. Med., 276, 125-131
8. Lane, J. M. et al (1969) Complications of Smallpox Vaccination, 1968. National Surveillance in the United States. New Eng. J. Med., 281, 1201-1208
9. Lane, J. M. & Millar, J. D. (1969) Routine childhood Vaccination Against Smallpox Reconsidered. New Eng. J. Med., 281, 1220-1224
10. Kempe, J. H. & Benenson, A. S. (1965) Smallpox Immunization in the United States. JAMA, 194, 161-166
11. Landrigan, P. J. (1972) Neurological Disorder Following Measles-Virus Vaccination. Presented at Annual Meeting, American Public Health Association, November 15
12. Communicable Disease Center (1966) Encephalitis Surveillance, 1965 Annual Summary, 1 July, pp. 12-15
13. Dick, G (1966) Smallpox: A Reconsideration of Public Health Policies. Progress in Medical Virology, 8, 1-29
14. Ehrengut, W. & Ehrengut-Lange, J. (1969) Postvaccinal Convulsions, Age Disposition and Prognosis. Proc. Symposium on Smallpox, Zagreb
15. Berger, K. & Puntigam, F. (1960) Die Altersdisposition bei postvakzinaler Enzephalitis. Dtsch. med. Wschr., 85, 1520-1524
16. Benenson, A. S. (1971) Possible Alternatives to Routine Smallpox Vaccination in the United States. Amer. J. Epidemiol. 93, 248-252
17. Foege, W. H. et al. (1971) Selective Epidemiologic Control in Smallpox Eradication. Amer. J. Epidemiol., 94, 311-315
18. Gelfand, H. M. & Posch, J. (1971) The Recent Outbreak of Smallpox in Meschede, West Germany. Amer. J. Epidemiol., 93, 234-237
19. WHO Weekly Epidemiological Record (1972), 47, 161-162
20. Egli, D. (1972) Yugoslavia. Conquest of an Epidemic. World Health, October, pp. 28-30

21. Mack, T. M. (1972) Smallpox in Europe, 1950-1971. J. Infect. Dis., 125, 161-169
22. Katz, S. L. (1971) The Case for Continuing "Routine" Childhood Smallpox Vaccination in the United States. Amer. J. Epidemiol., 93, 241-244
23. Bryce, J. (1802) Practical Observations on the Inoculation of Cowpox, Pointing out a Test of a Constitutional Affection in Those Cases in which the Local Inflammation is Slight, and in which no Fever is Perceptible. Edinburgh, Scotland, William Couch